EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Cindy Kaplan (REG 40,043) on 3/5/09.

1.   Claim 1 (currently amended): In a packet switched computer network, a method of estimating periodic worst-case delay for a class of traffic having an associated rate, the method comprising:

collecting traffic data at a queue of a router over a time interval, said queue associated with the class of traffic, the traffic data comprising packet size and arrival time of each packet arriving at the queue during the time interval;

calculating at a hardware processor, a burst-rate traffic profile responsive to the traffic data collected at said queue over the time interval and the associated rate, wherein the associated rate is a specified bandwidth for the class of traffic and calculating the burst-rate traffic profile comprises calculating a burst parameter based on the associated rate;

calculating at the hardware processor, a periodic worst-case delay for the burst-rate traffic profile by dividing the calculated burst parameter by a share of output link bandwidth allotted to said queue; and

transmitting said calculated periodic worst-case delay to a central device that collects said calculated periodic worst-case delay from the router and other routers along a path in the computer network and adds up said calculated periodic worst-case delays;

wherein the associated rate is set to a rate negotiated between a customer and a provider for the class of traffic.

2.   Claim 2 (canceled).

3.   Claim 3 (canceled).

4.   Claim 4 (canceled).

5.

6.   Claim 5 (canceled).

7.   Claim 6 (canceled).

8.   Claim 7 (canceled).

9.   Claim 8 (canceled).

10.   Claim 9 (Currently Amended): In a packet switched network, a method of estimating

worst-case queuing delay along a path, said path comprising routers, the method comprising:

periodically collecting at a central device, a rate parameter and a burst parameter associated with a queue for each of a plurality of routers, the burst parameter calculated based on a specified bandwidth;

calculating <u>by a hardware processor at the central device</u>, a periodic worst-case delay associated with the rate and burst parameters for said each of a plurality of routers, wherein calculating a periodic worst-case delay comprises dividing the burst parameter by a share of output link bandwidth allotted to the queue, wherein the share of output link bandwidth is greater than or equal to the specified bandwidth; and

adding up the calculated periodic worst-case delay associated with the routers along the path.

11.   Claim 10 (canceled).

12.   Claim 11 (Currently Amended): In a packet switched network, a method of estimating periodic worst-case queuing delay for a class of traffic at a router, the class of traffic having a negotiated rate corresponding to a specified bandwidth for the class of traffic, the method comprising:

receiving packets at an input interface of a router;

sending each packet to one of a plurality of streams responsive to a customer identification;

sending each packet in at least one of the plurality of streams to one of a plurality of queues responsive to <u>the class of traffic, the queue having the negotiated rate</u> ~~a class field, each of said plurality of queues having an associated rate~~;

monitoring an arrival time and size of said each packet at the one of the plurality of queues during an interval of time;

calculating <u>by a hardware processor,</u> a burst-rate traffic profile responsive to the arrival time and size of said each packet and the negotiated rate, wherein calculating a burst-rate traffic profile comprises calculating a burst parameter based on the negotiated rate; ~~and~~

calculating <u>by the hardware processor</u>, a periodic worst-case delay for the burst-rate

traffic profile by dividing the burst parameter by an output link capacity allotted to the queue

corresponding to the class of traffic; <u>and</u>

<u>transmitting said calculated periodic worst-case delay to a central device that collects said</u>

<u>calculated periodic worst-case delay from the router and other routers along a path in the</u>

<u>computer network and adds up said calculated periodic worst-case delays.</u>

13.   Claim 12 (canceled).

14.   Claim 13 (canceled).

15.   Claim 14 (Currently Amended): In a packet switched network, an apparatus for

estimating worst-case delay for a class of traffic having an associated rate, the apparatus

comprising:

a monitor that collects traffic data comprising arrival time and size of packets arriving at

a queue of a router over a time interval, said queue associated with the class of traffic;

a <u>hardware</u> processor; and

a computer readable medium coupled to the <u>hardware</u> processor and storing a computer

program comprising:

code that causes the <u>hardware</u> processor to receive the traffic data comprising

packet size and arrival time of each packet arriving at the queue during the time interval;

code that causes the <u>hardware</u> processor to calculate a burst-rate traffic profile

responsive to the collected traffic data and the associated rate, wherein the associated rate is a

specified bandwidth for the class of traffic and code that causes the <u>hardware</u> processor to

calculate a burst-rate traffic profile comprises code that causes the <u>hardware </u>processor to calculate a burst parameter based on the associated rate; ~~and~~

code that causes the <u>hardware</u> processor to calculate a periodic worst-case delay for the traffic profile by dividing the burst parameter by a share of output link bandwidth allotted to the queue, wherein the associated rate is set to a rate negotiated between a customer and a provider for the class of traffic; <u>and</u>

<u>code that causes the hardware processor to transmit said calculated periodic worst-case delay to a central device that collects said calculated periodic worst-case delay from the router and other routers along a path in the computer network and adds up said calculated periodic worst-case delays.</u>

16.   Claim 15 (canceled).

17.   Claim 16 (canceled).

18.   Claim 17 (canceled).

19.   Claim 18 (canceled).

20.   Claim 19 (previously presented): An apparatus as in claim 14, wherein the computer readable medium is a CD-ROM, floppy disk, flash memory, system memory, or hard drive.

21.   Claim 20 (Currently Amended): In a packet switched network, an apparatus for

estimating periodic worst-case queuing delay along a path, said path comprising routers, the

apparatus comprising:

        a monitor agent that periodically collects traffic parameters associated with a queue for

each of a plurality of routers and transmits said collected traffic parameters to a hardware

processor, said collected traffic parameters comprising a burst parameter and a rate parameter;

and

        a processor that can receive information from the monitor agent;

        a computer readable medium coupled to the hardware processor and storing a computer

program comprising:

        code that causes the hardware processor to receive burst and rate traffic

parameters collected said collected traffic parameters transmitted by the monitor agent;

        code that causes the hardware processor to calculate a periodic worst-case delay

associated with said collected [[the]] traffic parameters for said each of a plurality of routers by

dividing the burst parameter by a share of output link bandwidth allotted to the queue, wherein

the share of output link bandwidth is greater than or equal to [[the]] a specified bandwidth; and

        code that causes the hardware processor to add up the calculated periodic worst-

case delay associated with the routers along the path.

22.   Claim 21 (canceled).

23.   Claim 22 (previously presented): The apparatus of claim 20, wherein the computer

readable medium is a CD-ROM, floppy disk, flash memory, system memory, or hard drive.

24.   Claim 23 (Currently Amended): In a packet switched network, an apparatus for
estimating periodic worst-case delay for a class of traffic having an associated rate, the apparatus
comprising:

        hardware means for collecting traffic data comprising arrival time and size of packets
arriving at a queue of a router over a time interval, said queue associated with the class of traffic,
the traffic data comprising packet size and arrival time of each packet arriving at the queue
during the time interval;

        hardware means for calculating a burst-rate traffic profile responsive to the collected
traffic data and the associated rate, wherein the associated rate is a specified bandwidth for the
network and means for calculating the burst-rate traffic profile comprises means for calculating a
burst parameter based on the associated rate; [[and]]

        hardware means for calculating a periodic worst-case delay for the traffic profile by
dividing the burst parameter by a share of output link bandwidth allotted to said queue, wherein
the associated rate is set to a rate negotiated between a customer and a provider for the class of
traffic; and

        hardware means for transmitting said calculated periodic worst-case delay to a central
device that collects said calculated periodic worst-case delay from the router and other routers
along a path in the computer network and adds up said calculated periodic worst-case delays.

25.   Claim 24 (canceled).

26.   Claim 25 (Currently Amended): In a packet switched network, an apparatus for
estimating periodic worst-case queuing delay along a path, said path comprising routers, the
apparatus comprising:

hardware means for periodically collecting a [[rate]] traffic parameter comprising a rate

parameter and a burst parameter ~~traffic parameters~~ associated with a queue for each of a

plurality of routers, the burst ~~traffic~~ parameter calculated based on a specified bandwidth;

hardware means for calculating a periodic worst-case delay associated with the traffic

parameters for said each of a plurality of routers by dividing the burst parameter by a share of

output link bandwidth allotted to said queue, wherein the share of output link bandwidth is

greater than or equal to a specified bandwidth ~~the associated rate~~; and

hardware means for adding up the calculated periodic worst-case delay associated with

the routers along the path.

27.   Claim 26 (canceled).

28.   Claim 27 (Currently Amended): A computer program product for estimating periodic

worst-case delay at a queue in a packet switched network, the computer program product

comprising:

computer code that causes a hardware processor to collect traffic data comprising arrival

time and size of packets arriving at the queue of a router over a time interval, said traffic data

having ~~an associated~~ a negotiated rate corresponding to a specified bandwidth for a class of

traffic;

computer code that causes the hardware [[a]] processor to calculate a burst traffic

parameter for the collected traffic;

computer code that causes the hardware [[a]] processor to calculate a burst-rate traffic

profile responsive to the collected traffic data and the ~~associated~~ negotiated rate;

computer code that causes [[a]] the hardware processor to calculate a periodic worst-case

delay for the traffic profile by dividing the burst parameter by a share of output link bandwidth

allotted to said queue, wherein the share of output link bandwidth is greater than or equal to the ~~associated~~ negotiated rate; [[and]]

computer code that causes the hardware processor to transmit said calculated periodic worst-case delay to a central device that collects said calculated periodic worst-case delay from the router and other routers along a path in the computer network and adds up said calculated periodic worst-case delays; and

a computer readable medium storing said computer code.

29.   Claim 28 (canceled).

30.   Claim 29 (Currently Amended): A computer program product for estimating worst-case queuing delay along a path in a packet switched network, said path comprising routers, the computer program product comprising:

computer code that causes a hardware processor to collect traffic ~~burst and rate~~ parameters comprising a burst parameter and a rate parameter associated with a queue for each of a plurality of routers;

computer code that causes the hardware processor to calculate a periodic worst-case delay associated with the traffic parameters for said each of a plurality of routers by dividing the burst parameter by a share of output link bandwidth allotted to said queue, wherein the share of output link bandwidth is greater than or equal to ~~the associated~~ a negotiated rate corresponding to a specified bandwidth for a class of traffic; and

computer code that causes the hardware processor to add up the calculated delay associated with the routers along the path; and

a computer readable ~~storage~~ medium storing said code.

31.   Claim 30 (canceled).

32.   Claim 31 (Currently Amended): In a packet switched network, a method of estimating

worst-case queuing delay along a path, said path comprising routers, the method comprising:

    periodically collecting at a central device, traffic data from said plurality of routers, said

traffic data comprising a burst parameter calculated based on an associated rate, the associated

rate comprising a specified bandwidth for a class of traffic;

    calculating by a hardware processor at the central device, periodic worst-case delay

associated with a queue for each of [[a]] said plurality of routers by dividing the burst parameter

by a share of output link bandwidth allotted to said queue, wherein the share of output link

bandwidth is greater than or equal to the associated rate;

    periodically collecting at the central device, periodic worst-case delay from each of said

plurality of routers; and

    adding up at the central device, the calculated periodic worst-case delay associated with

[[the]] said plurality of routers along the path.

33.   Claim 32 (canceled).

34.   Claim 33 (previously presented): The method of claim 1 wherein calculating the burst-

rate traffic profile comprises utilizing a token bucket.

35.   Claim 34 (previously presented): The method of claim 33 wherein the token bucket size

corresponds to a maximum burst rate.

36.   Claim 35 (previously presented): The method of claim 33 wherein a replenishment rate of the token bucket is based on the associated rate.

37.   Claim 36 (previously presented): The method of claim 1 wherein the burst parameter is calculated utilizing token buckets.

38.   Claim 37 (previously presented): The method of claim 1 wherein the associated rate is a maximum average bandwidth specified in a service level agreement.

39.   Claim 38 (previously presented): The method of claim 1 wherein the burst-rate traffic profile comprises a y-intercept corresponding to the calculated burst parameter and a slope corresponding to the associated rate.

40.   Claim 39 (previously presented): The method of claim 1 further comprising calculating a cumulative bandwidth profile having a slope equal to allocated bandwidth.

41.   Claim 40 (previously presented): The method of claim 1 further comprising calculating error of data by comparing collected data to the burst-rate traffic profile.

42.   Claim 41 (previously presented): The method of claim 40 further comprising calculating a new burst parameter if the error of data is higher than a predetermined limit.

43.   Claim 42 (Currently Amended): The apparatus of claim 14 wherein code that causes the

hardware processor to calculate the burst-rate traffic profile comprises code that causes the

hardware processor to utilize a token bucket.

44.   Claim 43 (previously presented): The apparatus of claim 42 wherein the token bucket

size corresponds to a maximum burst rate.

45.   Claim 44 (previously presented): The method of claim 9 wherein the burst parameter is

calculated utilizing token buckets.

46.   Claim 45 (previously presented): The method of claim 9 wherein the rate parameter is a

rate agreed to by a customer sending the traffic data.

47.   Claim 46 (previously presented): The method of claim 11 further comprising calculating

error of data by comparing collected data to the burst-rate traffic profile.

48.   Claim 47 (previously presented): The apparatus of claim 23 wherein the burst- rate traffic

profile comprises a y-intercept corresponding to the calculated burst parameter and a slope

corresponding to the associated rate.

49.   Claim 48 (previously presented): The apparatus of claim 14 wherein said share of output

link bandwidth allotted to said queue comprises a hypothetical bandwidth allocation.

50.   Claim 49 (previously presented): The apparatus of claim 14 wherein the negotiated rate

comprises a hypothetical negotiated rate.

51.   Claim 50 (previously presented): The method of claim 1 further comprising calculating a

hypothetical bandwidth allocation for said queue based on a specified periodic worst-case delay.

52.   Claim 51 (Cancelled)

/Patrice Winder/

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